9.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

9.1 Introduction

This section presents a detailed description, evaluation and comparison of the seven (7) potential remedial alternatives developed and described in Section 8.0, which include the following:

Alternative 1: No Further Action
Alternative 2: Monitored Natural Attenuation
Alternative 3: Containment Based Remediation
Alternative 4: On-Site Thermal Treatment Based Remediation
Alternative 5: Biotreatment Based Remediation
Alternative 6: Off-Site Remediation Based Alternative
Alternative 7: Combination Alternative

During the detailed analysis of remedial alternatives, each alternative is assessed against nine (9) evaluation criteria, which are described in Section 9.2 and 9.3. The results of this assessment are then used to compare the remedial alternatives and identify the key tradeoffs among them. This assessment is presented in Section 9.4. This approach for analyzing alternatives is designed to provide sufficient information to 1) allow comparison of the potential remedial alternatives in the FS Report; and 2) facilitate the process by which EPA will ultimately select a remedy to address the contamination in the source areas at the Site. Following issuance and EPA approval of the FS Report, EPA will issue 1) the Proposed Remedial Action Plan (PRAP), which documents EPA's preferred remedial alternative (remedy) for OU-2; and 2) the Record of Decision (ROD), which presents EPA's selected remedy for OU-2.

9.2 Evaluation Criteria

As required by CERCLA, each remedial alternative listed above has been evaluated using nine (9) specific evaluation criteria (see Table 9-1). These criteria serve as the basis for conducting the detailed analysis of remedial alternatives during the FS and for subsequently selecting an appropriate remedy for OU-2. The first two (2) criteria are called ***threshold criteria*** and must be met by each remedial alternative. The next five (5) evaluation criteria are the primary ***balancing criteria*** upon which the detailed analysis is based. The final two (2) evaluation criteria are called ***modifying criteria*** and are used to evaluate state and community acceptance. These modifying criteria will be evaluated following state and public comment on the FS Report and the PRAP, and will be described in detail in the OU-2 ROD.

Table 9-1
CERCLA Evaluation Criteria

Threshold Criteria	Balancing Criteria	Modifying Criteria
Overall protection of human health and the environment	Long-term effectiveness and permanence	State acceptance
Compliance with ARARs	Reduction of toxicity, mobility or volume	Community acceptance
	Short-term effectiveness	
	Implementability	
	Cost	

9.2.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Protection of human health and the environment is based on an evaluation of the remedial alternative's ability to meet the remedial action objectives. This evaluation includes an estimate of the potential risks to human health and the environment both during (i.e., short-term risks) and following (i.e., long-term risks) implementation of the remedial alternative. For the site, long-term risks are included in the development of the PRGs (Section 6.0). Thus, those alternatives that meet the PRGs essentially meet the remedial action objectives for the Site.

9.2.2 COMPLIANCE WITH ARARS

Each remedial alternative is evaluated to determine whether it complies with Federal and State ARARs. ARARs are identified and discussed in Section 4.2.

9.2.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

This criterion requires an evaluation of the long-term risks remaining at the Site after implementation of the remedy. Issues addressed for each remedial alternative include the magnitude of the long-term, residual risk, the adequacy of controls used to manage the existing OU-2 media and the long-term reliability of the management controls.

9.2.4 REDUCTION OF TOXICITY, MOBILITY OR VOLUME

This criterion addressed the CERCLA preference for remedial alternatives that permanently and significantly reduce the toxicity, mobility or volume of hazardous material through treatment. Each remedial alternative is evaluated based on the degree to which it destroys or treats hazardous material; the expected reduction in toxicity, mobility or volume; the extent to which the treatment is irreversible; and the types and quantities of residuals that will remain after treatment.

9.2.5 SHORT-TERM EFFECTIVENESS

The evaluation of short-term effectiveness is based on the degree of protectiveness of human health achieved during construction and implementation of the remedy. Key factors considered in this evaluation are potential implementation risks to the community and site workers, mitigation measures for addressing those potential risks and the time required to complete the on-site construction work.

9.2.6 IMPLEMENTABILITY

The evaluation of the implementability of a remedial alternative is based on three factors: 1) technical feasibility; 2) administrative feasibility; and 3) availability of services and materials. Technical feasibility takes into consideration the difficulties that may be encountered during construction and operation of the remedy, the reliability of the technologies that make up the remedial alternative and the ability to monitor the effectiveness of the remedy. Administrative feasibility includes coordination with other regulators, such as obtaining permits and/or approvals for various on-site and off-site activities. Availability of services and materials includes assessment of the necessary equipment, specialists, materials and off-site treatment, storage and disposal capacities. All of these factors affect the overall implementation schedule of each remedial alternative.

9.2.7 COST

Evaluation of the cost associated with each remedial alternative for the Site includes estimation of capital costs and (O&M) costs, exclusive of the OU-1 groundwater extraction, treatment and recharge system (GERS). Capital costs consist of direct costs (i.e. labor, materials and equipment) and indirect costs (i.e., engineering, management and permits). O&M costs include operating labor, maintenance, monitoring and utilities. Because the estimated costs are pre-engineering numbers, there is an appreciable amount of uncertainty in the estimates. Although the costs are uncertain, they are suitable for the comparison among the alternatives, given that the same cost basis was used for each.

9.2.8 STATE ACCEPTANCE

Input from the New Jersey Department of Environmental Protection (NJDEP) will be incorporated by EPA during review and approval of the draft FS Report. Communication with NJDEP has occurred during the FS process to facilitate addressing concerns and issues.

9.2.9 COMMUNITY ACCEPTANCE

Evaluation of the community responses and/or concerns about the potential remedial alternatives will be made by EPA after the draft FS Report is issued. EPA will address comments received during public meetings and public availability sessions as well as written comments on the draft FS Report. The public comments will be considered during the review and approval of the draft FS Report, and will be integrated into the Proposed Remedial Action Plan (PRAP), which describes EPA's preferred remedy, and the Record of Decision (ROD), which describes EPA's selected remedy. Community concerns, based on a variety of communications, have been identified in the FS process.

9.3 Detailed Analysis of Individual Remedial Alternatives

The remedial alternatives developed for the Site, as described in Section 8.0, and evaluated below are combinations of response actions and technologies/process options. They cover a range of options from no further action through containment, *in situ* treatment and *ex situ* treatment.

9.3.1 ALTERNATIVE 1: NO FURTHER ACTION

9.3.1.1 Description

This alternative assumes that no action is taken in the source areas other than the systems that are currently in place. In place systems are the GERS, in which hydraulic containment is achieved, caps over the Drum Disposal Area and Lime Sludge Disposal Area, fencing and other institutional controls that are currently active at the site. Also, because the waste disposed in the Lime Sludge Disposal Area has been stabilized, stabilization is also considered a part of the current system. This alternative is described in Table 8.4.

9.3.1.2 Evaluation

9.3.1.2.1 Overall Protection of Human Health and the Environment

This alternative is protective with respect to the groundwater exposure pathway because the GERS is considered effective in containment and institutional controls prevent uses of contaminated groundwater from the Site. Because no further work is required at the site except for monitoring and the continued operation of the GERS, and other in-place systems and processes, until aquifer restoration is complete, this alternative presents the minimum risk of all the alternatives to the remediation worker or site visitor due to potential exposure or safety concerns. Although considered protective, as described above, this alternative does not meet PRGs for OU-2.

9.3.1.2.2 Compliance with ARARs:

Because no remedial actions would be taken other than the GERS, no action-specific or current chemical specific ARARs apply to OU-2.

9.3.1.2.3 Long-Term Effectiveness and Permanence

<u>Magnitude of residual risks</u>: Some of the contaminants in the Site soils and other materials will be degraded by naturally occurring microorganisms. Rainwater infiltration through unsaturated zone soils and non-soil materials will result in the flushing of contaminant mass, reducing the mass remaining in the soil and thus the magnitude of the future mass flux to groundwater. Flushing in the unsaturated zone is reduced in rate, though not eliminated, in sources that are currently capped, the Drum Disposal Area and the Lime Sludge Disposal Area. Groundwater flow through the sources in the saturated zone (i.e., the Equalization Basins) will flush contaminants from the aquifer material. It is estimated that these natural processes would require hundreds of years to achieve aquifer restoration, based on modeling results.

These groundwater-based risks are controlled by the GERS pumping and associated fencing and institutional controls. GERS optimization to facilitate aquifer restoration is part of this and all other alternatives for the Site, which will further control potential groundwater exposure risks.

<u>Adequacy of controls:</u> The controls currently in place at the Site, restrictions on the use of groundwater, fencing and the continued operation of the GERS, which contains the groundwater plume, are adequate for the control of potential risks posed by the materials at the Site. These systems will be in place for the foreseeable future.

Reliability of controls: The continued operation of the GERS requires the presence of a trained staff on-Site. This ensures the reliability of this system for the foreseeable future. The GERS will continue in operation until restoration of the aquifer is achieved. Ongoing monitoring of groundwater hydraulic quality data collected during this operation will ensure the reliability of this system. The GERS will also be optimized to achieve aquifer restoration and respond to changing groundwater quality distributions effected by the pumping and changes in mass flux from sources.

9.3.1.2.4 Reduction of Toxicity, Mobility or Volume

In the No Further Action alternative, little reduction of toxicity, mobility or volume of contaminated materials is provided. This alternative relies on the relatively slow, naturally occurring processes of biodegradation and flushing to remove contaminant mass from the sources. The GERS contains the sources. Mobility of COCs is reduced in the two sources that are currently capped, the Drum Disposal Area and Lime Sludge Disposal Area by reducing the volume of water percolating through the contaminated unsaturated zone material.

9.3.1.2.5 Short-Term Effectiveness

This alternative would not actively remediate subsurface soils or other materials. Because there are no associated construction activities, risks to remediation and construction workers are minimal. Potential risks associated with sampling of soil and groundwater during monitoring activities are addressed by the adherence to protective worker practices, standards and equipment. The same applies to operators of the GERS.

9.3.1.2.6 Implementability

Technical feasibility: The technical feasibility of this alternative is high. It is the system that is currently implemented at the Site, including hydraulic containment effected by GERS operation, the caps in place in the Drum Disposal Area and Lime Sludge Disposal Area, the institutional controls preventing the use of Site groundwater and other access controls such as the fencing and gate security system.

Administrative feasibility: The administrative feasibility of this alternative is high. The current administrative practices will remain in effect under this alternative.

Availability of services and materials: Services and materials required for this alternative are available.

9.3.1.2.7 Cost

The costs associated with this alternative are the base case, and do not involve any costs in addition to those for the GERS. For that reason, the costs of this alternative with respect to OU-2 is taken as $0 million (MM).

9.3.2 ALTERNATIVE 2: MONITORED NATURAL ATTENUATION

9.3.2.1 Description

This alternative includes the elements in the No Further Action Alternative, with the additional key features of the application of monitored natural attenuation to groundwater and sources and the removal and off-site treatment/disposal of the drums in the Stacked Drum Area (Table 8.4). A description of Monitored Natural Attenuation (MNA) and how it is implemented at a site is described in Section 7.2.5.

MNA would be applied to all sources at the Site. The drums in the Stacked Drum Area will be excavated and the drum contents appropriately treated or disposed (off-site thermal or off-site disposal for non-hazardous materials). Drums will be excavated, inspected, segregated and assigned to a treatment. Following classification, the drum contents will be bulked with similar material prior to treatment. The disposition of the drums in the Stacked Drum Area is described in section 8.2.1, except that no on-site thermal or biotreatment would occur. Following excavation of the drums, clean fill will be brought to the Stacked Drum Area, the area graded and capped. A cap would be installed in the Filtercake Disposal Area to address any potential risks associated with surface soil in that area. Sections of the Lime Sludge Disposal Area, in which samples do not pass TCLP for arsenic, if any, will the stabilized in this alternative.

9.3.2.2 Comparison to NCP Criteria

9.3.2.2.1 Overall Protection of Human Health and the Environment

The Monitored Natural Attenuation alternative will not meet PRGs for the Site. This alternative is protective with respect to the groundwater exposure pathway because the GERS is effective in containment and institutional controls prevent use of contaminated groundwater from the Site. This alternative is considered qualitatively more protective than the No Further Action Alternative because more detailed monitoring, additional modeling and data analysis is required to demonstrate the efficacy of natural processes in mitigating the contamination in the sources and associated groundwater.

Furthermore, the implementation of Monitored Natural Attenuation requires contingency plans in the event that the objectives of this alternative are not met. The cap to be installed in the Filtercake disposal area will address potential surface soil risks. The removal of the drums in the Stacked Drum Area will eliminate potential future release of contaminants from these intact drums to the soil and groundwater. This latter process will take approximately one 1.5 years to complete.

9.3.2.2.2 Compliance with ARARs

Action specific ARARS (N.J.A.C. 7:26E) will be met in the implementation of monitored natural attenuation for the Site. As for the excavation and disposition of the drums and associated soil in the Stacked Drum Area, all action-specific ARARs will be met. The drums will go to Resource Conservation and Recovery Act (RCRA) permitted treatment, storage and disposal (TSD) facilities for treatment and/or disposal.

9.3.2.2.3 Long-Term Effectiveness and Permanence

<u>Magnitude of residual risks</u>: The potential for future release of contaminants to the soil and groundwater from the intact drums in the Stacked Drum Area is eliminated in this alternative. Drum removal would require approximately 1.5 years. As described for No Further Action, all of the other sources would continue to leach to groundwater for hundreds of years, based on modeling results. Some of the contaminants in the Site soils and other materials will be degraded by naturally occurring microorganisms. Rainwater infiltration through unsaturated zone soils and non-soil materials will result in the flushing of contaminant mass, reducing the mass remaining in the soil and thus the magnitude of the future mass flux to groundwater. Groundwater flow through the sources in the saturated zone, i.e., the Equalizaiton Basins, will flush contaminants from the aquifer material.

Flushing in the unsaturated zone is significantly reduced, though not eliminated, in sources that are currently capped, the Drum Disposal Area and the Lime Sludge Disposal Area. The cap to be installed in the Filtercake Disposal Area will also prevent water flux through the unsaturated zone. Following completion of the excavation activities, the cap placed over the filled area will prevent the percolation of precipitation through and material left behind containing residual contamination. By this means, the caps would reduce mass flux to the groundwater in these two source areas.

Mass flushed from sources is captured by GERS, eliminating the possibility for exposure by means of the groundwater pathway. Thus groundwater-based potential risks are controlled by the GERS pumping, caps in the Drum Disposal Area and Lime Sludge Disposal Area and associated fencing and institutional controls. The cap in the Filtercake Disposal Area would address any potential risks associated with surface soils in that area.

Potential risks to site remediation and construction workers involved in the removal and handling of the drums and their contents would be addressed by the use of safe worker practices, standards and equipment. Appropriate monitoring, engineering controls and emission controls during excavation and handling activities will be conducted.

Adequacy of controls: The controls currently in place at the Site, restrictions on the use of groundwater, fencing and the continued operation of the GERS, which contains the groundwater plume, are adequate for the control of potential risks posed by the materials at the Site. These systems will be in place for the foreseeable future, until aquifer restoration is achieved or until Monitored Natural Attenuation is applicable to the Site without GERS. The elimination of the stacked drums from the Site is adequate to prevent potential future releases from these drums. Following completion of the excavation activities, the cap placed over the filled area will prevent the percolation of precipitation through and material left behind containing residual contamination.

Reliability of controls: The continued operation of the GERS requires the presence of a trained staff. This ensures the reliability of this system for the foreseeable future. The GERS will continue in operation until restoration of the aquifer is achieved. Ongoing monitoring of groundwater hydraulic quality data collected during this operation will ensure the reliability of this system. The GERS will also be optimized to achieve aquifer restoration and respond to changing groundwater quality distributions effected by the pumping and changes in mass flux from sources. The interpretation of the data collected to support Monitored Natural Attenuation will aid greatly in this optimization process, facilitating aquifer restoration. During excavation of the drums in the Stacked Drum Area, monitoring and engineering controls will be in place. Annual maintenance of the caps in the Drum Disposal Area and Filtercake Disposal Area ensures their reliability.

9.3.2.2.4 Reduction of Toxicity, Mobility or Volume

With the removal of the approximately 30,000 drums in the Stacked Drum Area, with subsequent treatment or disposal off-Site, reduction in waste volume is achieved in the Drum Disposal Area. Mobility of COCs is reduced in the two sources that are currently capped, the Drum Disposal Area and Lime Sludge Disposal Area, as well as in the Filtercake Disposal Area, which will be capped in this alternative. In the other sources, little reduction of toxicity, mobility or volume of contaminated materials is provided. This alternative relies on the relatively slow, naturally occurring processes of biodegradation and flushing to remove contaminant mass from the sources. These natural processes would require significantly longer than 30 years, probably centuries, to reduce mass flux from source zones to meet PRGs. The GERS system contains the sources.

9.3.2.2.5 Short-Term Effectiveness

Other than for the removal of the stacked drums and the cap placed over the Filtercake Disposal Area, this alternative would not actively remediate subsurface soils or other materials. Potential risks to site remediation and construction workers associated with the excavation and handling of the drums in the Stacked Drum Area will be addressed by means of the implementation of safe worker practices, standards and equipment. An approved, site-specific health and safety plan will be implemented and trained personnel will perform the work. These residual risks become non-existent once the *ex situ* remediation activities are completed, which are expected to take approximately 1.5 years to complete.

Potential risks associated with sampling of soil and groundwater during monitoring activities are addressed by the adherence to protective worker practices, standards and equipment. A current, site specific health and safety plan governs this work. The same applies to operators of the GERS.

9.3.2.2.6 Implementability

Technical feasibility: The technical feasibility of this alternative is high. Much of this alternative is currently being implemented at the Site, including hydraulic containment effected by GERS operation, the caps in place in the Drum Disposal Area and Lime Sludge Disposal Area, the institutional controls preventing the use of Site groundwater and other access controls such as the fencing and gate security system. The technical feasibility of excavation, removal, inspection and off-site treatment and/or disposal of the drums in the Stacked Drum Area has been demonstrated in a test pit program completed in that area, where approximately 300 drums were excavated and subsequently treated/disposed off-site.

Administrative feasibility: The administrative feasibility of this alternative is high. Construction and erosion control permits will have to be obtained for the excavation and related construction activities. The drums will be sent to RCRA approved facilities for treatment/disposal. Institutional controls on the use of groundwater and access to the Site are currently in effect and will remain in place during implementation of this alternative.

Availability of services and materials: Services, equipment and materials required for this alternative are available. The availability of capacity for off-site treatment of the drum contents, i.e., incinerator capacity, may affect the implementation schedule.

9.3.2.2.7 Cost

The total cost for this alternative is estimated to be $45.6 MM. As explained for the No Further Action Alternative, this cost does not include those associated with the GERS. The major cost item for this alternative is the excavation, handling and treatment/disposal of the drums in the Stacked Drum Area, $21.2 MM. Monitored Natural Attenuation requires a more extensive monitoring program to support its objectives than that already in place at the site to support the GERS. There would also be modeling and reporting requirements associated with it.

9.3.3 ALTERNATIVE 3: CONTAINMENT BASED REMEDIATION

9.3.3.1 Description

The focus of this alternative is the containment of source areas as a means of controlling mass flux of contaminants from source areas to groundwater. This alternative includes hydraulic and physical containment (primarily capping) of the source areas (Table 8.5). The sources to which physical containment (caps and/or vertical barriers) would be applied in this alternative are the Non-Intact Drum Area, Stacked Drum Area, Iron Filings Area and Eastern Area of the Drum Disposal Area, the Standpipe Burner Area, Filtercake Disposal Area, Equalization Basins, Former South Dye Area, Former Building 108/Underground Storage Tank (UST) Area, and the Backfilled Lagoon Area. The caps currently in place in the Drum Disposal Area and Lime Sludge Disposal Area will be upgraded or replaced, as necessary. Hydraulic containment is implemented for all of the sources in this alternative. Hydraulic containment is focused on the Primary Cohansey Member, with wells installed, as appropriate (see Section 8.2.1). Perched water management is also part of this alternative, as described in section 8.2.1. Sections of the Lime Sludge Disposal Area, in which samples do not pass TCLP for arsenic, if any, will the stabilized in this alternative. Stabilization of portions of the two former sludge drying lagoons in the Backfilled Lagoon Area is also included for the purpose of increasing the stability of this area for cap installation and related construction activities. The drums in the Stacked Drum Area will be addressed in this alternative as described in section 8.2.1, with the exception that on-site treatment or on-site disposal are not available in this alternative. Following excavation of the drums, clean fill will be brought to the Stacked Drum Area, the area graded and capped.

9.3.3.2 Comparison to NCP Criteria

9.3.3.2.1 Overall Protection of Human Health and the Environment

This alternative provides adequate protectiveness of human health and the environment and meets the PRGs for the site. The PRGs are met through the reduction in mass flux to groundwater from the sources effected by the containment measures. This containment, the GERS and institutional controls eliminate potential groundwater exposure, thus ensuring protectiveness. The cap in the Filtercake Disposal area addresses any potential risk associated with surficial soil in that area. This alternative protects site remediation and construction workers by using safe work practices, standards and equipment. These residual risks become non-existent once the *ex situ* remediation activities are completed.

9.3.3.2.2 Compliance with ARARs

All action-specific ARARs will be met for the excavation, handling and disposition of the drums and associated soil in the Stacked Drum Area. The drums will go to RCRA permitted TSD facilities for treatment and/or disposal. All action-specific ARARS for the design and construction of the containment systems will be met in this alternative, including requirements for erosion control and construction permits.

9.3.3.2.3 Long-Term Effectiveness and Permanence

<u>Magnitude of residual risks</u>: The potential for future release of contaminants to the soil and groundwater from the intact drums in the Stacked Drum Area is eliminated in this alternative. Some of the contaminants in the Site soils and other materials will be degraded by naturally occurring microorganisms. Flushing of water through the unsaturated zone is largely eliminated in most of the sources (Drum Disposal Area, Stand Pipe Burner Area, Filtercake Disposal Area, Lime Sludge Disposal Area, Equalization Basins, Former South Dye Area, Former Building 108/UST Area and the Backfilled Lagoon Area) by means of caps and perched water management. This essentially eliminates mass flux from the unsaturated zone to the Primary Cohansey aquifer over the long term. In perched water management, which will be implemented in the Former South Dye Area, Drum Disposal Area and Filtercake Disposal Area, the unsaturated zone is extended through the Yellow Clay and to the top of the Primary Cohansey, due to the removal of the perched water within those sources. Groundwater flow through the sources in the saturated zone (i.e., the Equalization Basins) will flush contaminants from the aquifer material. The mass flushed from sources is captured by the GERS, eliminating the possibility for

exposure by means of the groundwater pathway. The installation of a cap in the Filtercake Disposal Area for containment would address any potential risks associated with surface soils in that area.

Adequacy of controls: The controls currently in place at the Site, restrictions on the use of groundwater, fencing and the continued operation of the GERS, which contains the groundwater plume, are adequate for the control of potential risks posed by the materials at the Site. These systems will be in place for the foreseeable future, until aquifer restoration is achieved or until Monitored Natural Attenuation is applicable to the Site without the GERS. The elimination of most of the water flow in sources above the Yellow Clay by the caps and perched water management controls is adequate to essentially eliminate the mass flux of contaminants from these source zones to the Primary Cohansey. The elimination of the stacked drums from the Site is adequate to prevent potential future releases from these drums. During excavation of the drums in the Stacked Drum Area, monitoring and engineering controls will be in place; these will be adequate to protect Site remediation and construction workers.

Reliability of controls: The continued operation of the GERS requires the presence of a trained staff. This ensures the reliability of this system for the foreseeable future. The GERS will continue to operate until restoration of the aquifer is achieved or until Monitored Natural Attenuation without the GERS can be implemented at the Site. Ongoing monitoring of groundwater hydraulic quality data will ensure the reliability of this system. The GERS will also be optimized to facilitate aquifer restoration and respond to changing groundwater quality distributions effected by the pumping and changes in mass flux from the sources. Maintenance activities performed on the caps and perched water management systems will ensure the reliability of those controls. Reliability will also be ensured by monitoring specifically related to the performance of these features of the remedial alternative. Engineering controls would be implemented during all phases of the work (construction of the caps and perched water management systems and excavation of the drums in the Stacked Drum Area). During excavation of the drums in the Stacked Drum Area, monitoring and engineering controls will be in place.

9.3.3.2.4 Reduction of Toxicity, Mobility or Volume

Reduction in volume of contaminated materials is achieved by the removal of the stacked drums in the Stacked Drum Area. This activity would require approximately 1.5 years to complete. In the other sources, the slow processes of natural attenuation, particularly biodegradation, will achieve reduction in volume. Flushing processes are reduced to negligible in unsaturated zone sources. The caps and perched water management systems in the source areas will reduce the mobility of the contaminants by eliminating water flow through the sources above the Primary Cohansey water table. The perched water zone would be eliminated in sources underlain by the Yellow Clay by the perched water management system. This alternative reduces mobility of contaminants by decreasing the opportunity for contaminants to leach to the groundwater. Stabilization of material in the Lime Sludge Disposal Area, if needed, will reduce the mobility of arsenic in that source. Stabilization of the material in the Backfilled Lagoons, though conducted primarily for the purpose of providing stability of the wastewater treatment solids so the caps and related construction activities will be supported, will also reduce the mobility of metals in that material.

9.3.3.2.5 Short-Term Effectiveness

Short term effectiveness would be achieved in the Stacked Drum Area by the removal of the intact drums. The caps and perched water management systems in the other sources will be effective in the short term for reducing the mobility of the contaminants by eliminating the mechanism by which they are leaching into the Primary Cohansey groundwater. Approximately 1.5 years would be required to remove the drums. The installation of a cap in the Filtercake Disposal Area will eliminate any potential risks associated with surface soils in that area.

Potential risks to construction and site remediation workers associated with the excavation and handling of the drums in the Stacked Drum Area will be minimized by means of the implementation of safe worker practices, standards and equipment. An approved, site-specific health and safety plan and the use of trained personnel will ensure adherence to these safe practices. The same applies to the construction of the caps and perched water management systems. The potential for exposure by ingestion, inhalation and absorption through the skin of contaminants during excavation activities will be minimized during all construction activities at the Site, by these means. These residual risks become non-existent once the *ex situ* remediation activities are completed.

Potential risks associated with sampling of soil and groundwater during monitoring activities are addressd by the adherence to protective worker practices, standards and equipment. A current, site-specific health and safety plan governs these activities. The same applies to operation of the GERS.

9.3.3.2.6 Implementability

<u>Technical feasibility:</u> The overall technical feasibility of this alternative is high. Portions of this alternative currently being implemented at the Site include hydraulic containment effected by GERS operation, the caps in place in the Drum Disposal Area and Lime Sludge Disposal Area, the institutional

controls preventing the use of Site groundwater and other access controls such as the fencing and gate security system.

All of the techniques for the installation of the caps and perched water management systems have a long history of successful implementation in the field of site remediation, as well as in general engineering practice. The technical feasibility of excavation, removal, inspection and off-site treatment and/or disposal of the drums in the Stacked Drum Area has been demonstrated in a test pit program completed in that area, where approximately 300 drums were excavated. It is estimated that approximately 1.5 years would be required to remove the drums.

Administrative feasibility: The administrative feasibility of this alternative is high. Construction and erosion control permits will have to be obtained for the excavation and related construction activities. Excavated drums will be sent to RCRA approved TSD facilities for treatment/disposal. Institutional controls on the use of groundwater and access to the Site are currently in effect and will remain in place during implementation of this alternative.

Availability of services and materials: Services, equipment and materials required for this alternative are available. The availability of capacity for off-site treatment of the drums (i.e., incinerator capacity) may affect the implementation schedule.

9.3.3.2.7 Cost

The total estimated cost for this alternative is $51.5 MM. These costs include the excavation and off-site treatment/disposal of the stacked drums and the installation of the caps and perched water management systems. Additional GERS pumping wells are also included.

9.3.4 ALTERNATIVE 4: ON-SITE THERMAL TREATMENT BASED REMEDIATION

9.3.4.1 Description

In this alternative, on-site thermal treatment would be applied to all organic contaminated material included as PRGs in the unsaturated zone sources (Table 8.6). As described in Section 8.2.1, unsaturated zone sources include the perched water zone above the Yellow Clay and the Yellow Clay, where present. Sources are the Non-Intact Drum Area Stacked Drum Area and Iron Filings Area of the Drum Disposal Area, the Standpipe Burner Area, Filtercake Disposal Area/Trench Disposal Area, Equalization Basins, Former South Dye Area, Former Building 108/UST Area, Borrow Compactor Area and the Backfilled Lagoon Area). Material, particularly debris, excavated from the Non-Intact Drum Area, Stacked Drum

Area and the Trench Disposal Area that are contaminated yet do not require thermal treatment will be decontaminated and appropriately disposed.

The drums in the Stacked Drum Area will be excavated and the drum contents appropriately treated or disposed. The drums will be handled as described in Section 8.2.1, except that the on-site biotreatment option for drums listed in that section will not be implemented.

Material requiring remediation within the saturated zone (i.e., Equalization Basins) will be remediated by *in situ* bioremediation and hydraulic containment (Section 8.2.1). Perched water management, as described in Section 8.2.1, will also be part of this alternative in the south plume source areas (Drum Disposal Area, Standpipe Burner Area and Filtercake Disposal Area) and Former South Dye Area in the north plume. The Lime Sludge Disposal Area is capped to prevent percolation of water through this area.

Treatment residues from the on-site thermal treatment process meeting applicable standards will be used on-site as fill. Treated residues from the Backfilled Lagoons and Filtercake Disposal Area that fail TCLP for metals will be stabilized. This stabilized material will also be used as fill. Areas into which this fill will be placed are those excavated during the remediation implementation.

9.3.4.2 Comparison to NCP Criteria

9.3.4.2.1 Overall Protection of Human Health and the Environment

This alternative meets the PRGs for the Site and is protective. Potential risks to remediation and construction workers are addressed by safe worker practices, standards and equipment.

9.3.4.2.2 Compliance with ARARs

All action-specific ARARs will be met for the excavation and disposition of all contaminated materials excavated. All chemical and action-specific ARARs associated with the permitting and operation of the thermal treatment unit will be met, including the rigorous requirements of an air permit. ARARs for the return of treatment residues to the Site will be met. All action-specific ARARS for the design and construction of the containment systems will be met in this alternative, including the requirements for erosion control and construction permits.

9.3.4.2.3 Long-Term Effectiveness and Permanence

<u>Magnitude of residual risks</u>: PRGs will be met in this alternative, which would require approximately 2 to 3 years to complete. The potential for future release of contaminants to the soil and groundwater from

the intact drums in the Stacked Drum Area is eliminated in this alternative. Potential future mass flux to the groundwater is eliminated by the *ex situ* treatment of material requiring remediation based on PRGs above the Cohansey Yellow Clay in source areas underlain by the clay and above the Primary Cohansey water table in sources where the clay is absent. Perched water management will eliminate flushing of water through the sources above and within the Yellow Clay, thus eliminating contaminant mass flux to the Primary Cohansey, as described in Section 9.3.3.2. The construction of a cap in the Filtercake Disposal Area for containment would eliminate any potential risks associated with surface soil in that area. *In situ* bioremediation of saturated zone sources reduces potential future flux to groundwater by reducing contaminant mass. Groundwater flow through the sources in the saturated zone (i.e., the Equalization Basins) will flush contaminants from the aquifer material. Residual mass flushed from sources is captured by the GERS, eliminating the possibility for human exposure by means of the groundwater pathway, in conjunction with institutional controls on groundwater use.

Potential risks to Site remediation and construction workers due to exposure to vapors from the treatment unit, and vapors, dust and contact with soils during excavation and handling is addressed by the use of safe work practices, equipment, and standards. This work will be conducted by trained personnel. These residual risks become non-existent once the *ex situ* remediation activities are completed.

<u>Adequacy of controls:</u> Implementation of this alternative requires the presence of a trained staff during implementation. This includes operation of the thermal treatment unit and the GERS. All challenges encountered during remediation will be addressed by this team, ensuring the adequacy of controls. Engineering, emission (for the thermal treatment unit) and monitoring controls will also be in place during implementation of this alternative. The controls currently in place at the Site, restrictions on the use of groundwater, fencing and the continued operation of the GERS, will be in place for the foreseeable future, until aquifer restoration is achieved or until Monitored Natural Attenuation is applicable to the Site without the GERS. The GERS will also be optimized to achieve aquifer restoration and respond to changing groundwater quality distributions effected by the pumping and source remediation.

<u>Reliability of controls</u>: The operation of the thermal treatment unit and continued operation of the GERS requires the presence of a trained staff. This ensures the reliability of this system for the foreseeable future. Performance monitoring of the thermal unit will be conducted to ensure the reliability of the unit. Testing of treatment residues will also be conducted to ensure that the performance of the thermal treatment is as designed. The GERS will continue in operation until restoration of the aquifer is achieved

or until Monitored Natural Attenuation can be applied to the Site. Ongoing monitoring of groundwater will ensure the reliability of the GERS. Maintenance and monitoring performed on the perched water management systems will ensure the reliability of those controls.

9.3.4.2.4 Reduction of Toxicity, Mobility or Volume

Reduction in volume of contaminated materials is achieved by the removal and thermal treatment of materials in the unsaturated zone sources, including the drums in the Stacked Drum Area. Thermal treatment would remediate the excavated material with a high degree of efficiency, destroying greater than 99 percent of the organic contaminant mass, achieving low cleanup levels, including tentatively identified compounds (TICs). Material at the Site, particularly the sandy soil, is well suited for the application of thermal treatment. In the saturated zone sources (i.e., the Equalization Basins or other areas) *in situ* bioremediation will reduce volume of contaminated media. This alternative, by means of perched water management, reduces mobility of contaminants by decreasing the opportunity for contaminants to leach to groundwater, as described in Section 9.3.3.2. Stabilization of material in the Lime Sludge Disposal Area, if needed, will reduce the mobility of arsenic in that source. Stabilization of the treated material excavated from the Backfilled Lagoons, if necessary will reduce the mobility of metals.

9.3.4.2.5 Short-Term Effectiveness

Short term effectiveness in meeting PRGs will be achieved in this alternative by the removal of unsaturated zone material exceeding PRGs in source areas, thereby eliminated a source of mass flux to the groundwater. This would require approximately 2 to 3 years to achieve. The thermal treatment process, itself, would require less than one year of operation. Perched water management systems in the Drum Disposal Area, Standpipe Burner Area, Filtercake Disposal Area and Former South Dye Area will be effective in the short term for reducing the mobility of the contaminants within and above the Yellow Clay, as described in Section 9.3.3.2. Perched water management eliminates the mechanism by which contaminants leach into the Primary Cohansey groundwater, as described previously. Mass flux from saturated zone sources (i.e., Equalization Basins or other areas) will be reduced over the short term by *in situ* bioremediation, though this effect is slower by several years than that for *ex situ* remediation and containment of unsaturated zone sources.

Potential risks to construction and site remediation workers associated with the excavation and handling of materials from the sources, as well as the operation of the thermal treatment unit, will be addressed by the use of safe worker practices, standards and equipment. This will be done according to an approved, site-specific health and safety plan and requires the use of trained personnel. These residual risks become non-existent once the *ex situ* remediation activities are completed.

Potential risks associated with sampling of soil and groundwater during monitoring activities are addressed by the adherence to protective worker practices, standards and equipment. A current, site-specific Health and Safety Plan governs those activities at the present. The same applies to the current operators of the GERS. These practices will continue.

9.3.4.2.6 Implementability

<u>Technical feasibility:</u> The overall technical feasibility of this alternative is high. On-site thermal treatment has been used at many remediation sites. A vendor treatability test would need to be conducted to determine the operating conditions for the thermal treatment unit. As described in Section 9.3.3.2, implementation of perched water management systems involves standard engineering practice. Portions of this alternative currently being implemented at the Site include hydraulic containment effected by GERS operation, the caps in place in the Drum Disposal Area and Lime Sludge Disposal Area, the institutional controls preventing the use of groundwater and other access controls such as the fencing and gate security system. The technical feasibility of excavation, removal, inspection and treatment and/or disposal of the drums in the Stacked Drum Area has been demonstrated in a test pit program completed in that area, where approximately 300 drums were excavated. It is estimated that this alternative will require 2 to 3 years to implement, with operations of the thermal process requiring less than one year.

<u>Administrative feasibility:</u> The thermal treatment unit and its location will have to be approved and coordinated. Operation of the thermal treatment unit would have to meet the rigorous requirements of an air permit. Construction and erosion control permits will have to be obtained for excavation and related construction activities. Institutional controls on the use of groundwater and access to the Site are currently in effect and will remain in place during implementation of this alternative.

<u>Availability of services and materials:</u> Services, equipment and materials required for this alternative are available.

9.3.4.2.7 Cost

The total estimated cost for this alternative is $96.9 MM. These costs include all excavation activities, installation and operation of the thermal treatment unit, off-site treatment of approximately 10,000 drums and approximately 2,000 cubic yards of soil (materials not amenable to treatment by the on-site thermal treatment process), installation of perched water management systems, and installation and operation of *in situ* bioremediation. As in the other alternatives, operation of the GERS is not included in the total.

9.3.5 ALTERNATIVE 5: BIOTREATMENT BASED REMEDIATION

9.3.5.1 Description

In this alternative, on-site, *ex situ* biotreatment (composting) would be applied to material to meet PRGs in the unsaturated zone in the source areas (Table 8.7). These source areas are the Non-Intact Drum Area, Stacked Drum Area and Iron Filings Area of the Drum Disposal Area, the Standpipe Burner Area, Filtercake Disposal Area/Trench Disposal Area, Equalization Basins, Former South Dye Area, Former Building 108/UST Area, Borrow Compactor Area and the Backfilled Lagoon Area. Material that can be excavated, requires treatment and is inappropriate for *ex situ* bioremediation will be sent off-site for treatment (i.e., incineration or disposal). Material, particularly debris, excavated from the Non-Intact Drum Area, Stacked Drum Area and the Trench Disposal Area that is contaminated, will be decontaminated and appropriately disposed.

The drums and their contents will be handled just as described in Section 8.2.1, except as follows. Those drums that are appropriate for biotreatment will undergo on-site, *ex situ,* biotreatment (see Section 8.2.1). On-site thermal treatment is not available for treatment of drums.

Material within the saturated zone that requires remediation based on PRGs (Equalization Basins) will be remediated by *in situ* bioremediation and hydraulic containment (see Section 8.2.1). Perched water management, as described in Section 8.2.1, will also be part of this alternative in the south plume source areas (Drum Disposal Area, Standpipe Burner Area and Filtercake Disposal Area) and Former South Dye Area in the north plume. The Lime Sludge Disposal Area is capped to prevent percolation of water through waste in this area. Sections of the Lime Sludge Disposal Area, in which samples do not pass TCLP for arsenic, if any, will the stabilized in this alternative. Treatment residues (from on-site treatment only) will be addressed in the same manner as described for the residues of thermal treatment in Alternative 4 above.

9.3.5.2 Comparison to NCP Criteria

9.3.5.2.1 Overall Protection of Human Health and the Environment

This alternative meets the PRGs for the Site and is adequately protective. Potential risks to remediation and construction workers are addressed by safe worker practices, standards and equipment.

9.3.5.2.2 Compliance with ARARs

All action-specific ARARs will be met for the excavation and disposition of all contaminated materials excavated. All action-specific ARARs associated with the permitting and operation of the biotreatment unit will be met. ARARs for the return of treatment residues to the Site will be met. All action-specific ARARS for the design and construction of the containment systems will be met in this alternative, including the requirements for erosion control and construction permits.

9.3.5.2.3 Long-Term Effectiveness and Permanence

<u>Magnitude of residual risks</u>: PRGs will be met in this alternative. The potential for future release of contaminants to groundwater from sources and treatment residues associated with this alternative is similar to that described in section 9.3.4.2. The installation of a cap in the Filtercake Disposal Area for containment would eliminate any potential risks associated with surface soil in that area. Containment of contaminants that happen to be released is also effected by the GERS until aquifer restoration is achieved or until Monitored Natural Attenuation can be implemented at the Site without the GERS.

Risks to remediation and construction workers at the Site related to potential exposure to vapors from the biotreatment unit, and vapors, dust and contact with soils during excavation and handling is addressed by the use of safe worker practices, equipment, and standards. This work would be conducted by trained personnel. These residual risks become non-existent once the *ex situ* remediation activities are completed, which is estimated to require 8 years.

<u>Adequacy of controls:</u> Implementation of this alternative requires the presence of a trained staff during implementation. This includes operation of the biotreatment unit and the GERS. All challenges encountered during remediation will be addressed by this team, ensuring the adequacy of controls. Engineering, emission (biotreatment unit) and monitoring controls will be in place during implementation of this alternative. The controls currently in place at the Site, restrictions on the use of groundwater, fencing and the continued operation of the GERS, will be in place for the foreseeable

future, until aquifer restoration is achieved or until Monitored Natural Attenuation is applicable to the Site without the GERS.

Reliability of controls: The operation of the biotreatment unit and continued operation of the GERS requires the presence of a trained staff. This ensures the reliability of this system during implementation. Performance monitoring of the biotreatment unit will ensure its reliability. Testing of treatment residues will also be conducted to ensure that the performance of biotreatment is as designed. As in all other alternatives, the GERS will continue in operation until restoration of the aquifer is achieved or until Monitored Natural Attenuation can be applied to the Site. Ongoing monitoring of groundwater will ensure the reliability of the GERS. The GERS will also be optimized to facilitate aquifer restoration and respond to changing groundwater quality distributions effected by the pumping and source remediation. Maintenance on the perched water management systems will ensure the reliability of those controls.

9.3.5.2.4 Reduction of Toxicity, Mobility or Volume

As discussed for the previous alternative, reduction in volume of contaminated materials is achieved by the removal of materials to meet PRGs in the unsaturated zone sources. Biotreatment of these materials also will reduce volume, as well as off-site treatment of some of the drums. There is uncertainty regarding the degree of reduction in the mass of contaminants during biotreatment. Treatment efficiencies of some compounds, such as 1,2,3-trichloropropane, tetrachloroethene or some tentatively identified compounds (TICS) may be relatively low. In such cases, secondary treatment of material, e.g., anaerobic biotreatment or enhanced air flow, may be required to meet treatment standards. It is anticipated that, in saturated zone sources, *in situ* bioremediation will reduce volume, though at rates slower than the *ex situ* process.

Flushing of contaminants to the Primary Cohansey groundwater would be reduced to near zero in the sources underlain by Yellow Clay, due to the elimination of water flow by caps and perched water management. This will reduce the mobility of the contaminants by eliminating this water flow through the source materials, as described in Section 9.3.3.2. Stabilization of material in the Lime Sludge Disposal Area, if needed, will reduce the mobility of arsenic in that source. Stabilization of the treated material excavated from the Backfilled Lagoon Area, if necessary, will reduce the mobility of metals.

9.3.5.2.5 Short-Term Effectiveness

Short term effectiveness in meeting PRGs will be achieved in this alternative by the removal of unsaturated zone material exceeding PRGs in source areas, thereby eliminated a source of mass flux to the groundwater. An estimated 8 years would be required to complete implementation of the *ex situ* biotreatment. As discussed previously, perched water management systems in sources underlain by the Yellow Clay will be effective in the short term for reducing the mobility of the contaminants by eliminating the mechanism by which they leach to the Primary Cohansey groundwater. With the installation of a cap over the Filtercake Disposal Area, any potential risks associated with surface soil would be addressed. Mass flux from saturated zone sources will be reduced over the short term by *in situ* bioremediation, though this effect is slower than that effected for *ex situ* remediation and containment.

Potential risks to construction and site remediation workers associated with the excavation and handling of materials from the sources, as well as the operation of the biotreatment unit, will be addressed by means of the use of safe worker practices, standards and equipment. This will be done according to an approved, site-specific health and safety plan and requires the use of trained personnel. These residual risks become non-existent once the *ex situ* remediation activities are completed, estimated to require 8 years.

Potential risks associated with sampling of soil and groundwater during monitoring activities are addressed by the adherence to protective worker practices, standards and equipment. A current, site-specific Health and Safety Plan governs those activities at the present. The same applies to the current operators of the GERS. These practices will continue.

9.3.5.2.6 Implementability

<u>Technical feasibility:</u> The overall technical feasibility of this alternative is high. On-site, *ex situ* biotreatment has been used at many remediation sites. The implementation of *ex situ* biotreatment for the types and variety of compounds reflected in the COCs at the Site is innovative. For this reason, it is expected that challenges will arise during implementation. Although these issues can be addressed satisfactorily, they could add time and complexity to the alternative. The technical feasibility of this technology has been tested for contaminated media from the Site in laboratory and bench-scale studies. A pilot study is ongoing to develop additional information for the implementation of this technology.

As described in Section 9.3.3.2, implementation of perched water management systems involved standard engineering practice. Portions of this alternative currently being implemented at the Site include hydraulic containment effected by GERS operation, the caps in place in the Drum Disposal Area and Lime Sludge Disposal Area, the institutional controls preventing the use of Site groundwater and other access controls such as the fencing and gate security system. The technical feasibility of excavation, removal, inspection and treatment and/or disposal of the drums in the Stacked Drum Area has been demonstrated in a test pit program completed in that area, where approximately 300 drums were excavated. Completion of the biotreatment is estimated to require 8 years.

Administrative feasibility: The biotreatment unit will have to be approved and coordinated. Treatment standards for biotreatment will have to be approved, pending the results of the pilot study. Secondary treatment would be specified, if needed. Construction and erosion control permits will have to be obtained for excavation and related construction activities. Institutional controls on the use of groundwater and access to the Site are currently in effect and will remain in place during implementation of this alternative.

Availability of services and materials: Services, equipment and materials required for this alternative are available. The biotreatment unit will be construct on-site from readily available materials.

9.3.5.2.7 Cost

The total estimated cost for this alternative is $90.1 MM. These costs include all excavation activities, installation and operation of the biotreatment unit, off-site treatment of approximately 11,000 drums and approximately 5,000 cubic yards of soil (materials not amenable to biotreatment), installation of perched water management systems, and installation and operation of *in situ* bioremediation. As in the other alternatives, operation of the GERS is not included in the total.

9.3.6 ALTERNATIVE 6: OFF-SITE REMEDIATION BASED ALTERNATIVE

9.3.6.1 Description

In this alternative, material in the source area unsaturated zones will be excavated and transferred to an off-site treatment facility or disposed in an off-site landfill to meet PRGs (Table 8.9). The source areas are the Non-Intact Drum Area, Stacked Drum Area and Iron Filings Area of the Drum Disposal Area, the Standpipe Burner Area, Filtercake Disposal Area/Trench Disposal Area, Equalization Basins, Former South Dye Area, Former Building 108/UST Area, Borrow Compactor Area and the Backfilled Lagoon Area. Materials disposed in an off-site landfill are those neither requiring treatment or for which it is not appropriate, such as for some types of construction debris or inert non-hazardous material. An assumption made in the development of this alternative is that on-site disposal or treatment is not available.

The drums and their contents will be handled as described in Section 8.2.1, above, except as follows. Drum contents requiring treatment will be incinerated, off-site. Contents not requiring treatment will be landfilled, off-site.

Material within the saturated zone requiring treatment based on PRGs (Equalization Basins) will be remediated by *in situ* bioremediation and hydraulic containment (see Section 8.2.1). Perched water management, as described in Section 8.2.1, is also part of this alternative in the south plume source areas (Drum Disposal Area, Stand Pipe Burner Area and Filtercake Disposal Area) and Former South Dye Area in the north plume. The Backfilled Lagoon Area would not be capped in this alternative because essentially all of the wastewater treatment solids will be removed. The Lime Sludge Disposal (Lime Sludge Disposal Area) area is capped to prevent percolation of water through this area. Sections of the Lime Sludge Disposal Area, in which samples do not pass TCLP for arsenic, if any, will be stabilized, *in situ*, in this alternative. There will be no treatment residues to handle in this alternative. Clean fill will be brought on Site to bring all excavations to grade.

9.3.6.2 Comparison to NCP Criteria

9.3.6.2.1 Overall Protection of Human Health and the Environment

This alternative meets the PRGs for the Site and is adequately protective. Potential risks to remediation and construction workers are addressed by safe worker practices, standards and equipment. Risks associated with truck transfer of contaminated material from the Site to the off-site treatment/disposal facility(ies) will be addressed, though not eliminated, by following safe worker practices and Department of Transportation (DOT) requirements. At least five accidents involving off-site transfer are expected, based on DOT data. It is estimated that the execution of this alternative, the transfer of soils and other materials to off-site treatment/disposal, would require 9 years to complete, based on the rate of acceptance of such materials at off-site treatment facilities.

9.3.6.2.2 Compliance with ARARs

For the excavation and disposition of all contaminated materials exceeding PRGs, all action-specific ARARs will be met. All contaminated material transferred from the Site will be treated and/or disposed at a RCRA permitted TSD facilities. All ARARs associated with the transfer of the contaminated materials from the Site will be met, including DOT regulations. All action-specific ARARS for the design and construction of the containment systems will be met in this alternative, including the requirements for erosion control and construction permits.

9.3.6.2.3 Long-Term Effectiveness and Permanence

Magnitude of residual risk: PRGs will be met in this alternative. The potential for future release of contaminants to groundwater from sources and treatment residues associated with this alternative is similar to that described in Sections 9.3.4.2 and 9.3.5.2. Containment of contaminants is effected by GERS until aquifer restoration is achieved or until Monitored Natural Attenuation can be applied to the Site without the GERS. With the installation of a cap in the Filtercake Disposal Area, any potential risk associated with surface soil is eliminated.

Adequacy of controls: Implementation of this alternative requires the presence of a trained staff. This includes all excavation and materials handling activities and the GERS operation. All challenges encountered during remediation will be addressed by this team, ensuring the adequacy of controls. Engineering and monitoring controls will also be in place during implementation of this alternative. The controls currently in place at the Site, restrictions on the use of groundwater, fencing and the continued operation of the GERS, will be in place until aquifer restoration is achieved or until Monitored Natural Attenuation is applicable to the Site without the GERS. Optimization of the GERS will ensure the adequacy of this measure as contaminant distributions change in the Site groundwater.

Reliability of controls: The implementation of this alternative and continued operation of the GERS requires the presence of a trained staff. This ensures the reliability of this remedial alternative. Monitoring of all excavation, handling and transfer activities will be conducted to ensure the reliability of the process. Audits of the RCRA approved facilities to which the contaminated material is transferred will ensure the reliability of the final disposition of that material. The reliability of the GERS and perched water control systems are ensured as described in previous alternatives.

9.3.6.2.4 Reduction of Toxicity, Mobility or Volume

Reduction in volume of contaminated materials is achieved by the removal of materials that require remediation based on PRGs above the Cohansey Yellow Clay in source areas underlain by the clay and above the Primary Cohansey water table in sources where the clay is absent. The stacked drums in the Drum Disposal Area are included in this material. In the saturated zone sources, *in situ* bioremediation will reduce volume.

Flushing of contaminants to the Primary Cohansey groundwater is reduced to near zero in the sources underlain by the Yellow Clay, as described in Section 9.3.3.2, due to the implementation of perched water control, in addition to the removal of materials to meet PRGs. Thus, mobility of residual contaminants is reduced. Stabilization of material in the Lime Sludge Disposal Area, if needed, will reduce the mobility of arsenic in that source.

9.3.6.2.5 Short-Term Effectiveness

Short term effectiveness will be achieved in this alternative by the removal of material to meet PRGs in source areas overlying the Cohansey Yellow Clay where it is present (including sources currently in the perched water zone) or overlying the Primary Cohansey water table where the clay is absent. This would eliminate a source of mass flux to the groundwater in the short term. Implementation of the removal of material would require approximately 9 years. Off-site treatment and disposal will limit the rate of the excavation on-site. Just as discussed previously, perched water management systems in sources underlain by the Yellow Clay will be effective for reducing the mobility of the contaminants. Mass flux from saturated zone sources will be reduced over the short term by *in situ* bioremediation, though this effect is slower than that for *ex situ* remediation and perched water management.

Potential risks to construction and site remediation workers associated with the excavation and handling of materials from the sources will be addressed by safe worker practices, standards and equipment. This will be done according to an approved, site-specific health and safety plan and requires the use of trained personnel. Risks (safety and potential exposure) associated with the transfer of contaminated material from the Site to the treatment/disposal facility will be addressed, though not eliminated, by the strict adherence to safe work practices and all applicable regulations (DOT). Nevertheless, at least five accidents involving truck transport are expected, based on DOT information. These residual risks become non-existent once the *ex situ* remediation activities are completed, which is estimated to require up to 9 years.

Potential risks associated with sampling of soil and groundwater during monitoring activities are addressed by the adherence to protective worker practices, standards and equipment. A current, site-specific Health and Safety Plan governs those activities at the present. The same applies to the current operation of the GERS. These practices will continue.

9.3.6.2.6 Implementability

<u>Technical feasibility:</u> The overall technical feasibility of this alternative is moderate. Although excavation and off-site treatment/disposal of contaminated media has been successfully implemented at numerous Superfund sites, there have been none involving volumes for commercial incineration similar to that which would be addressed at this Site (approximately 150,000 cubic yards). All excavation,

handling and transfer techniques and equipment that would be used in this alternative are widely used. As described in Section 9.3.3.2, implementation of perched water management systems involved standard engineering practice. Portions of this alternative currently being implemented at the Site include hydraulic containment effected by GERS operation, the caps in place in the Drum Disposal Area and Lime Sludge Disposal Area, the institutional controls preventing the use of Site groundwater and other access controls such as the fencing and gate security system. The technical feasibility of excavation, removal, inspection and treatment and/or disposal of the drums in the Stacked Drum Area has been demonstrated in a test pit program completed in that area, where approximately 300 drums were excavated.

Administrative feasibility: Implementation of this alternative would require coordination and approvals involving all communities along the route(s) over which material would be transported between the Site and the treatment/disposal facility(ies). Contaminated material will be transferred to RCRA permitted facilities for treatment/disposal. All applicable regulations, particularly DOT, will be met in the shipment of materials off-site. Construction and erosion control permits will have to be obtained for excavation and related construction activities. Institutional controls on the use of groundwater and access to the Site are currently in effect and will remain in place during implementation of this alternative.

Availability of services and materials: Services, equipment and materials required for the on-site portion of this alternative are available. Trucks for shipment of the contaminated material are also available. The off-site treatment and/or disposal capacity for the volume of material requiring handling in this alternative is not readily available.

9.3.6.2.7 Cost

The total estimated cost for this alternative is $201 MM. These costs include excavation and filling activities, off-site treatment/disposal of contaminated soil and drum contents, and installation of perched water management systems. As in the other alternatives, operation of the GERS is not included in the total.

9.3.7 ALTERNATIVE 7, COMBINATION ALTERNATIVE

9.3.7.1 Description

This alternative was developed from the assumption that both on-site, *ex situ* thermal treatment and biotreatment will be used for the material most suited for each technology in order to meet PRGs. The use of both technologies allows the optimum treatment of materials on-site based on their physical and chemical characteristics (Table 8.9). Off-Site treatment and disposal are also used for the appropriate materials in this alternative. The source areas are the Non-Intact Drum Area, Stacked Drum Area and Iron Filings Area of the Drum Disposal Area, the Standpipe Burner Area, Filtercake Disposal Area/Trench Disposal Area, Equalization Basins, Former South Dye Area, Former Building 108/UST Area, Borrow Compactor Area and the Backfilled Lagoon Area.

The determination of which excavated material from the unsaturated zone sources, exclusive of the stacked drums, is suitable for which treatment follows. Material contaminated with primarily biodegradable organic COCs, at low to moderate concentrations, will be treated by *ex situ* biotreatment. Material contaminated with primarily organic COCs at relatively high concentrations and/or with relatively high proportions of organic compounds that are recalcitrant will undergo on-Site thermal treatment. Material, particularly debris, excavated from the Non-Intact Drum Area, Stacked Drum Area and the Trench Disposal Area that are contaminated, will be decontaminated and appropriately disposed. The drums in the Stacked Drum Area and their contents will be handled as described in Section 8.2.1.

Perched water management, as described in Section 8.2.1, is also part of this alternative in the south plume source areas (Drum Disposal Area, Standpipe Burner Area and Filtercake Disposal Area) and Former South Dye Area in the north plume. Material in the saturated zone requiring remediation based on PRGs (Equalization Basins) will be addressed by *in situ* bioremediation and hydraulic containment (see Section 8.2.1). The Lime Sludge Disposal Area is capped to prevent percolation of water through this area. Sections of the Lime Sludge Disposal Area, in which samples do not pass TCLP for arsenic, if any, will be stabilized, *in situ,* in this alternative. Treatment residues (from on-site treatment only) will be addressed in the same manner as described for the residues of thermal treatment described in the Thermal Treatment Based Alternative.

9.3.7.2 Comparison to NCP Criteria

9.3.7.2.1 Overall Protection of Human Health and the Environment

This alternative meets the PRGs for the Site and is protective. Potential risks to remediation and construction workers are addressed by safe worker practices, standards and equipment.

9.3.7.2.2 Compliance with ARARs

For the excavation and disposition of all contaminated materials in the unsaturated zone requiring treatment based on PRGs, all action-specific ARARs will be met. All action-specific ARARs associated with the permitting and operation of the biotreatment and thermal treatment units will be met, including the rigorous requirements of an air permit for the thermal unit. All action-specific ARARS for the design and construction of the containment systems will be met in this alternative, including the requirements for erosion control and construction permits. All ARARs associated with the disposition of the treatment residues will be met.

9.3.7.2.3 Long-Term Effectiveness and Permanence

<u>Magnitude of residual risks</u>: PRGs will be met in this alternative. The potential for future release of contaminants to groundwater from sources and treatment residues associated with this alternative is similar to that described in Section 9.3.4.2. The installation of a cap in the Filtercake Disposal Area for containment would eliminate any potential risks associated with surface soil in that area. Containment of contaminants that happen to be released is also effected by GERS until aquifer restoration is achieved or until Monitored Natural Attenuation can be implemented at the Site without the GERS. The e*x situ* treatment of material excavated to meet PRGs for the Site is estimated to require four years to complete, four years for biotreatment and less than one year for thermal treatment. *In situ* bioremediation of saturated zone sources (former EQ Basins or other areas) reduces potential future releases to groundwater by eliminating contaminant mass. Groundwater flow through the sources in the saturated zone, i.e., the Equalizaiton Basins, will flush contaminants from the aquifer material. Residual mass flushed from sources is captured by GERS, eliminating the possibility for human exposure by means of the groundwater pathway, in conjunction with institutional controls prohibiting the use of groundwater.

<u>Adequacy of controls:</u> Implementation of this alternative requires the presence of a trained staff during implementation. This includes operation of the thermal treatment unit, the biotreatment unit and of GERS. All challenges encountered during remediation will be addressed by this team, ensuring the

adequacy of controls. Engineering, emission (biotreatment and thermal treatment) and monitoring controls will also be in place during implementation of this alternative. The controls currently in place at the Site, restrictions on the use of groundwater, fencing and the continued operation of the GERS, will be in place until aquifer restoration is achieved or until Monitored Natural Attenuation is applicable to the Site without the GERS.

<u>Reliability of controls</u>: The operation of the thermal treatment unit, the biotreatment unit and continued operation of the GERS requires the presence of a trained staff. Performance monitoring of the thermal and biotreatment units will be conducted to ensure their reliability. Testing of treatment residues will also be conducted to ensure that the performance of the treatments is as designed. Ongoing monitoring of groundwater will ensure the reliability of the GERS. The GERS will also be optimized to achieve aquifer restoration and respond to changing groundwater quality distributions effected by the pumping and source remediation. Maintenance activities and monitoring performed on the perched water management systems will ensure the reliability of those controls.

9.3.7.2.4 Reduction of Toxicity, Mobility or Volume

Reduction in volume will be achieved by the removal and treatment of materials that require remediation based on PRGs above the Cohansey Yellow Clay in source areas underlain by the clay and above the Primary Cohansey water table in sources where the clay is absent. This includes the drums in the Stacked Drum Area. The on-site treatment processes will destroy contaminant mass. In the saturated zone sources, *in situ* bioremediation will reduce volume. Perched water management systems will eliminate flushing of contaminants through the sources underlain by and within the Yellow Clay, as described previously (Section 9.3.3.2), thereby reducing residual contaminant mobility. Stabilization of material in the Lime Sludge Disposal Area, if needed, will reduce the mobility of arsenic in that source. Stabilization of the treated material excavated from the Backfilled Lagoons, if necessary, will reduce the mobility of metals.

9.3.7.2.5 Short-Term Effectiveness

Short term effectiveness in meeting PRGs will be achieved by the removal of materials that require remediation based on PRGs above the Cohansey Yellow Clay in source areas underlain by the clay and above the Primary Cohansey water table in sources where the clay is absent. This will eliminate a source of mass flux to the groundwater. Perched water management systems, as discussed previously, will be effective in eliminating mass flux to groundwater in the Drum Disposal Area, Standpipe Burner Area, Filtercake Disposal Area and Former South Dye Area. Mass flux from saturated zone sources will be reduced over the short term by *in situ* bioremediation, though this effect is slower than that for *ex situ* remediation.

Potential risks to construction and site remediation workers associated with the excavation and handling of materials from the sources, as well as the operation of the thermal and biological treatment units, will be addressed by means of the use of safe worker practices, standards and equipment. This will be done according to an approved, site-specific health and safety plan and requires the use of trained personnel. These residual risks become non-existent once the *ex situ* remediation activities are completed, which is estimated to require four years, four years for biotreatment and less than one year for thermal treatment.

Potential risks associated with sampling of soil and groundwater during monitoring activities are addressed by the adherence to protective worker practices, standards and equipment. A current, site-specific Health and Safety Plan governs those activities at the present. The same applies to the current operation of the GERS. These practices will continue.

9.3.7.2.6 Implementability

Technical feasibility: The overall technical feasibility of this alternative is high. On-site thermal treatment and *ex situ* biotreatment have been used at many remediation sites. The use of both technologies allows the excavated materials to be treated optimally, based on their physical and chemical characteristics. A vendor treatability test would need to be conducted to determine the required operating conditions for the thermal treatment unit. Laboratory and bench-scale testing of biotreatment with site-specific, contaminated materials have demonstrated the technical feasibility of the use of this technology. A pilot study of biotreatment is being conducted to determine engineering and operating parameters for that technology. As described in Section 9.3.3.2, implementation of perched water management systems involved standard engineering practice. Portions of this alternative currently being implemented at the Site include hydraulic containment effected by GERS operation, the caps in place in the Drum Disposal Area and Lime Sludge Disposal Area, the institutional controls preventing the use of Site groundwater and other access controls such as the fencing and gate security system. The technical feasibility of excavation, removal, inspection and off-site treatment and/or disposal of the drums in the Stacked Drum Area has been demonstrated in a test pit program completed in that area, where approximately 300 drums were excavated.

Administrative feasibility: The thermal treatment and biological treatment units and their locations will have to be approved and coordinated. Operation of the thermal treatment unit would have to meet the rigorous requirements of an air permit. Vapor emissions control will also be a requirement for the biotreatment unit. Construction and erosion control permits will have to be obtained for excavation and related construction activities. Institutional controls on the use of groundwater and access to the Site are currently in effect and will remain in place during implementation of this alternative.

Availability of services and materials: Services, equipment and materials required for this alternative are available. The biotreatment unit will be constructed on-site from available materials and equipment.

9.3.7.2.7 Cost

The total estimated cost for this alternative is $83.2 MM. These costs include all excavation activities, installation and operation of the thermal and biological treatment units, off-site treatment of approximately 11,000 drums and approximately 2,000 cubic yards of soil (materials not amenable to treatment by the on-site treatment processes), installation of perched water management systems, and installation and operation of *in situ* bioremediation. As in the other alternatives, operation of the GERS is not included in the total.

9.4 Comparative Analysis of Alternatives

In Section 9.3, each remedial alternative was evaluated against seven (7) of the nine (9) CERCLA evaluation criteria. The remaining two (2) modifying criteria (state acceptance and community acceptance) will be considered by EPA during the draft FS Report review/approval and remedy selection process. To facilitate the determination of the most appropriate remedial alternative for OU-2, this section presents a comparative analysis of the potential remedial alternatives.

9.4.1.1 Overall Protection of Human Health and the Environment

All of the alternatives presented in this FS are adequately protective with respect to risks associated with potential exposure to contaminated groundwater. The GERS is considered effective in containment and institutional controls prevent use of contaminated groundwater from the Site. Access to the Site is controlled by fencing and on-site security. All of the alternatives contain these elements. Two alternatives, No Further Action and Monitored Natural Attenuation, do not meet the PRGs for the Site, which are defined in Section 6.0, even though they are considered protective for the reasons outlined above. The other five (5) alternatives meet the PRGs.

Only in the No Further Action Alternative is there a potential for future release to Site soil and groundwater from the stacked drums, which remain in the soil only in this alternative. Nevertheless, should such a release occur, the GERS would contain its effect on the groundwater.

All alternatives, except for No Further Action, involve the installation of a cap over the Filtercake Disposal Area. In this way, any potential risk associated with contact with surface soil in this area is addressed.

In considering overall protectiveness, the alternatives can be distinguished further in terms of short-term risks to remediation and construction workers at the Site during implementation. This short-term risk is minimal in the case of the No Further Action Alternative because there are no potential exposures in addition to those associated with the GERS. All other alternatives involve the excavation and treatment/disposal of the stacked drums in the Drum Disposal Area. Among these alternatives, the Monitored Natural Attenuation Based Alternative has the smallest associated potential risk during implementation, followed by the Containment Based Alternative, because these alternatives involve only the excavation of the drums and some soil with its off-site treatment/disposal. The Containment Based Alternative would involve excavation of some contaminated material in the installation of the perched water management systems and caps. Among the three (3) other alternatives, the Off-Site Remediation Based Alternative is unique in that it has the largest potential safety risk, a greater than 100 percent probability of an accident due to the large number of trucks and miles driven required to transfer the volume of waste to off-site treatment/disposal facilities. With the implementation of proper controls, the on-site treatment alternatives are roughly equivalent in terms of risk to remediation and construction workers.

9.4.1.2 Compliance With ARARs

All of the alternatives will comply with ARARs. There is no meaningful way to distinguish among the alternatives on this basis.

9.4.1.3 Long-Term Effectiveness and Permanence

<u>Magnitude of residual risks</u>: Permanence with respect to the Site is achieved for those alternatives that involve the excavation and treatment and/or off-site disposal of contaminated materials to meet PRGs. Those alternatives that result in the greatest removal of such contaminated materials and treat them to the greatest degree achieve the highest degree of permanence. Thus, the highest degree of permanence is achieved in the On-Site Thermal Treatment Based and the Off-Site Based Alternatives. In both

alternatives, contaminants are removed from the Site with a high degree of efficiency. Although the same amount of material is excavated and treated in the Bioremediation Based and Combination alternatives, the bioremediation process is less efficient than thermal treatment. However, this distinction may not be large in terms of potential impact to groundwater following treatment. Permanence is achieved to the smallest extent by the No Further Action Alternative. Permanence is achieved in only the Stacked Drum Area for the Monitored Natural Attenuation and Containment Based Remediation Alternatives. A relative ranking of the alternatives on the basis of permanence, most to least permanence, follows:

1. Thermal Treatment Based and Off-Site Based Remediation
2. Combination Alternative
3. Biotreatment Based Remediation

The following alternatives achieve permanence only in the Stacked Drum Area:

4. Monitored Natural Attenuation, Containment Based Remediation

The following alternative does not achieve permanence:

5. No Further Action

Residual risks to remediation and construction workers at the Site were discussed above, and will not be reiterated here, except to indicate that they are negligible in the No Further Action Alternative and maximal for the Off-Site Remediation Alternative.

<u>Adequacy of controls</u>: Controls that will be implemented in each of the alternatives are adequate. Although the necessary controls vary in complexity and difficulty to implement, none are beyond standard practice.

<u>Reliability of controls:</u> As described in the previous sections, the controls that would be implemented for each alternative are reliable.

<u>Reduction of Toxicity, Mobility or Volume:</u> In order of most to least reduction in toxicity, mobility and volume on the Site, the relative ranking of the alternatives is:

1. Thermal Treatment Based Remediation , Off-Site Based Remediation
2. Combination Alternative

3. Biotreatment Based Remediation
4. Containment Based Remediation
5. Monitored Natural Attenuation Based Remediation
6. No Further Action

In the Off-Site Based Remediation Alternative, all contaminants, organic and inorganic, contained in the excavated materials are removed from the Site. The assumption made in ordering the first, second and third ranked alternatives involving on-site treatment is that *ex situ* bioremediation is less efficient than thermal treatment. Thermal treatment typically removes greater than 99 percent of the contaminant mass, including tentatively identified compounds (TICS).

Containment ranks ahead of Monitored Natural Attenuation because the mobility of contaminants in the sources above the Primary Cohansey water table is significantly reduced in the former alternative by the elimination of water flow with caps and perched water management. This reduction in mobility is more significant than the faster natural flushing that would occur in Monitored Natural Attenuation. In both alternatives, the rate of volume reduction is slow. Monitored Natural Attenuation would require hundreds of years to reduce contaminant mass to acceptable levels (meet PRGs). Containment meets PRGs by reducing contaminant mobility over a much shorter time period. Monitored Natural Attenuation ranks ahead of No Further Action because excavation of the stacked drums and the installation of a cap in the Filtercake Disposal Area occur in the former but not the latter.

9.4.1.4 Short-Term Effectiveness

In terms of reduction of mass flux to groundwater to meet PRGs, the Containment Based, On-Site Thermal Treatment Based, Biotreatment Based, Combination and Off-Site Remediation Based alternatives are roughly equivalent. Note that the best case scenario for aquifer restoration is on the order of 30 years (the Time of Compliance). The implementation of each of these alternatives will take 1.5 to nine years. No Further Action and Monitored Natural Attenuation are less effective on that basis, because they do nothing to facilitate aquifer restoration.

Implementation times are an important factor to consider in evaluating the short-term effectiveness of the *ex situ* alternatives plus containment. Those actions that require less time to complete, all other factors considered equal, can be considered more effective over the short term, because they all involve addressing the same volumes of material that exceed PRGs. A ranking based on implementation times, from shortest to longest, for the *ex situ* alternatives, follows:

1. Containment Based Remediation (1.5 years for excavation of drums)
2. Thermal Treatment Based Remediation (2 years total, thermal treatment operations less than 1 year)
3. Combination Alternative (4 years, thermal treatment operations less than 1 year, biotreatment 4 years)
4. Biotreatment Based Remediation (8 years)
5. Off-site Based Remediation (9 years)

Short term risks to remediation and construction workers were discussed in Section 9.4.1.1. A relative ranking based upon short-term risks, from lowest to highest potential exposure or safety risk, as discussed previously, is:

1. No Further Action (No potential incremental risk)
2. Monitored Natural Attenuation (Potential risk associated with drum removal only)
3. Containment Based Remediation (Potential risk associated with drum removal and construction of containment systems)
4. On-Site Thermal Treatment Based Alternative, Biotreatment Based Alternative and Combination Alternative (Excavation, potential treatment related risks addressed through safe practices and equipment)
5. Off-Site Remediation Based Alternative (Greater than 100 percent probability of transport accident, same excavation risks as in (4) above)

9.4.1.5 Implementability

<u>Technical feasibility:</u> All of the alternatives are technically feasible and have been used at other remediation sites and make use of standard engineering practices. Among the alternatives, the one that is most technically feasible is the No Further Action Alternative, because it is currently being implemented. Monitored Natural Attenuation is also very easily implemented because it involves only the collection of soil and groundwater samples and the interpretation of data, in addition to the GERS, installation of a cap in the Filtercake Disposal Area and excavation and off-site treatment/disposal of the stacked drums. The remaining alternatives are feasible, though to different degrees. A ranking of the alternatives based on technical feasibility (ease of implementation) is:

1. No-Further Action
2. Monitored Natural Attenuation
3. Containment Based Remediation

4. Thermal Based,
5. Combination Based
6. Biotreatment Based
7. Off-Site Based Remediation

Among the on-site treatment based alternatives, thermal treatment is considered the most technically feasible because it has been implemented at numerous Superfund sites, is a well-developed technology, allows the greatest degree of control over the treatment process, operates with a high efficiency and requires the least time to achieve treatment. The implementation of this technology is well understood. The sandy soils and contaminants at the Site are well suited for thermal treatment.

Although implemented at many remediation sites, the implementation of *ex situ* biotreatment for the types and variety of compounds reflected in the COCs as well as other organic compounds at the Site is innovative. For this reason, it is expected that technical challenges will arise during implementation. Although these issues can be addressed satisfactorily, they could add time and complexity to the alternative. For this reason, biotreatment in the Biotreatment Based and Combination Alternatives is considered slightly less implementable than on-site thermal treatment.

Although excavation and off-site treatment/disposal of contaminated media has been successfully implemented at numerous Superfund sites, there have been none for commercial incineration involving volumes similar to that which would be addressed at this Site (approximately 150,000 cubic yards). For this reason, Off-Site Based Remediation is considered the least implementable of the alternatives.

<u>Administrative feasibility:</u> As in the case of technical feasibility, the alternatives that rank administratively the most feasible are the No Further Action Alternative and Monitored Natural Attenuation. The containment alternative ranks third most administratively feasible. More difficult among the latter alternatives are the two alternatives that involve on-site thermal treatment, due to permitting requirements and the rigorous conditions that would be imposed by an air permit. The alternative that ranks the least administratively feasible is the Off-site Based Remediation, because of the onerous requirement to coordinate and obtain approval of the route from each and every community through which the trucks would travel between the Site and the treatment/disposal facility(ies). Based on the above discussion. A relative ranking from most to least admininstratively feasible is:

1. No Further Action
2. Monitored Natural Attenuation

3. Containment Based Remediation
4. Biotreatment Based Remediation
5. Thermal Treatment Based Remediation and Combination Alternative
6. Off-Site Based Remediation

Availability of services and materials: The availability of services and materials required for the implementation of all of the alternatives, except for Off-Site Based Remediation, is adequate. Off-site treatment/disposal capacity is limited in terms of the rate at which materials can be accepted. The alternative requiring the least in terms of additional services and materials is No Further Action. The only additional resources required for Monitored Natural Attenuation are for the cap in the Filtercake Disposal Area and excavation and off-site treatment/disposal of the stacked drums. The Thermal, Biotreatment, Combination and Containment Based Alternatives both require services and materials that are currently available, in addition to those necessary to remove the drums, and should not present a challenge. Based on this discussion, a ranking of the alternatives on the basis of availability of services and materials, from most available to least available, is:

1. No Further Action
2. Monitored Natural Attenuation
3. Containment Based Remediation, Biotreatment Based Remediation, Combination Alternative, Thermal Treatment Based Remediation
4. Off-Site Based Remediation (Only alternative with a potentially significant limitation on availability)

9.4.1.6 Cost

Although the costs estimated for the alternatives are considered order of magnitude, they were calculated on the same basis and with similar assumptions for all alternatives, so a relative comparison can be made. In order of least to most costly, the alternatives are:

1. No Further Action ($0 MM)
2. Monitored Natural Attenuation ($45.6 MM)
3. Containment Based Remediation ($51.5 MM)
4. Combination Alternative ($83.2 MM)
5. Biotreatment Based Remediation ($90.1 MM)
6. Thermal Treatment Based Remediation ($96.9 MM)
7. Off-Site Remediation ($201 MM)

In interpreting this ranking, two points should be considered. First, the operation, maintenance and optimization of the GERS are included as an action in all of the alternatives, including the No Further Action alternative, but the costs associated with it were not. Currently, the operation and maintenance of the GERS costs approximately $4 MM per year. Second, because the costs presented here are predesign costs, there is a wide range of potential values associated with each alternative.